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EFFECT OF PLANT PHENOLOGY ON INFESTATION BY LEGUME POD BORER *MARUCA VITRATA* ON DOLICHOS BEAN

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ABSTRACT

The legume pod borer *Maruca vitrata* (F.) (Crambidae: Lepidoptera) causes considerable yield loss in major edible legumes including dolichos bean *Lablab purpureus* var. *typicus*. This study analyses the *M. vitrata* incidence and abundance in relation to the four plant parts during two consecutive cropping seasons of 2019. The results revealed that peak incidence of 80.00± 2.83% was in the 11th week after planting during rabi, 2019, and it was more in unopened flower buds (64.00± 8.76%) and mature pods (13.00± 0.80%). There existed significant differences between the four growth stages of the crop in the order- flower buds (maximum) > mature pods > immature pods > open flowers (least) during summer 2019. The occurrence of single and multiple larvae was more in the unopened flower buds (78.00± 3.35%) and mature pods (52.00± 3.35%).

Key words: *Maruca vitrata***,** *Lablab purpureus* var. *typicus***,** incidecne, plant growth stages, unopened/ open flowers, mature/ immature pods, single/ multiple larvae/ pod or bud

Dolichos bean or lablab (*Lablab purpureus* var. *typicus*) native to India is an important and nutritious vegetable (Pengelly and Maass, 2001; Maass, 2016). It is grown in approximately 0.085 million ha and with a production of 0.03 mt (Laxmi et al., 2015). Insect pests are the major constraints resulting in this low productivity, with about 18 insect pests (Jayasinghe et al., 2015; Khan et al., 2018). Notably, the lepidopterans feeding on the flowers and pods of food legumes cause significant yield losses (Rouf and Sardar, 2011; Sreekanth et al., 2019; Tagger et al., 2019; Sujayanand et al., 2021). Amongst this *M. vitrata* (Lepidoptera: Crambidae) is a serious legume pest with high damage potential and a wider host range (Jackai 1995; Sharma 1999; Margam et al., 2011; and Periasamy et al., 2015). In India, it infests most of the legumes cultivated widely across the country. It is an important pest of dolichos bean in India, which is highly preferred host (Rekha and Mallapur, 2007; Mallikarjuna et al., 2012). The incidence, abundance and extend of losses of this had been extensively studied globally on the major grain legumes viz., pigeonpea, cowpea and black gram. However, there exists a knowledge gap with respect to *M. vitrata* incidence on dolichos bean, in particular on its abundance on different development stages of flowers and pods, the data on which are crucial in framing a successful IPM strategy.

MATERIALS AND METHODS

The study was carried out at Narasipuram village (11.0152°N, 76.9326°E) of Coimbatore district. The level of *M. vitrata* infestation and abundance on dolichos bean (*Lablab purpureus* var. *typicus*) was assessed based on two developmental stages of flowers (fully opened flowers and flower buds) and pods (immature and mature) following the methodology of Jayasinghe et al. (2015). Plant parts were sampled during three successive cropping seasons of 2019. During the entire reproductive stage of the crop, 10 samples in each location were randomly collected from five locations in the field in a zig-zag manner representing the entire field. The samples from top five racemes of the plant were collected starting from 6th to 13th weeks after planting (WAP) each representing the developmental stages of flowers and pods. The collected samples were carefully dissected under a stereozoom microscope for the presence of *M. vitrata* larval stages and used for estimating the incidence and abundance.

The mean *M. vitrata* larval incidence (%) was estimated by the number of infested flowers or pods with the total number of flowers and pods sampled. The mean larval abundance from individual flowers and pods were calculated based on the total number of larva present in the flowers or pods sampled. At the same time, the larval length frequency (mm) was categorized into five stages relating to the larval instars and the mean % of single and multiple larvae counted from the sampled flower buds, open flowers, immature pods and mature pods. The mean % larval incidence and abundance data were subjected to arcs in and square root transformation, respectively before subjecting to ANOVA using the software AGRESS. The significance of differences was tested by F- values, while the significance of difference between the treatment mean values were compared by LSD (p=0.05).

RESULTS AND DISCUSSION

The data pertaining to incidence of *M. vitrata* in three consecutive seasons of 2019 on dolichos bean are given in Table 1. The intensity of larval incidence and abundance in fluctuated over time during the cropping season with a prominent peak being at the flowering stage which lies between 9 to 11 WAP. Throughout the study period, the overall incidence in flowers and pods was found to be maximum in rabi than in summer and kharif. These observations corroborate with those of Jayasinghe et al. (2015) that maximum incidence was in flowers than in pods during offseason in the yard-long bean. Sharma et al. (1999) also observed preference of *M. vitrata* larvae towards the flower buds rather than pods. The larval incidence fluctuates from the day of flowering to senescence; maximum of 80.00± 2.83% was noticed in flowers during rabi 2019 which coincides with the peak flowering and pod formation stage (10th WAP). Thus, present findings are consistent with the previous findings of Jackai (1981a) and Sharma et al. (1999) that the flower buds are the most preferred ovipositional sites for *M. vitrata*. In contrast, Taylor (1978) observed that the oviposition site for *M. vitrata* in cowpea was opened flowers and not the flower buds. The least incidence in flower (4.00 ± 2.19%) was observed in the late stage of the crop (13th WAP). The maximum of 68.00 ± 4.38% incidence in pods was during the 11th WAP of rabi 2019, and it was statistically significant among the eight weeks of observation. Similar findings were reported by Dharmasena et al. (1992) with 84% pod damage in pigeon pea; Hamming et al. (2008) abpout 25% pod damage in yard-long bean; Liao and Lin (2000) with 17-53% in cowpea and Zahid et al. (2008) with a pod damage of 18% in lablab and 20-30% in mung bean. The present contradict with those of Atachi and Ahohuendo (1989) and Jayasinghe et al. (2015) who observed a maximum larval density at 6 WAP on cowpea and yard-long bean, respectively with subsequent decline.

About the level of *M. vitrata* larval incidence in four developmental stages of dolichos bean viz., flower buds, open flowers, immature and mature pods depicted in Table 2 reveal significantl differences- the descending order being: flower buds (28.00± 6.83%) > mature pods (25.25± 7.39%) > immature pods (12.25± 3.24%) > open flowers (5.00± 1.96%) during summer 2019. These observations corroborate with those of Jayasinghe et al. (2015) that flower buds revealed maximum larval abundance rather than opened flowers. But the present results contradict with those of Atachi et al. (2002) that larval infestation was observed only on the opened flowers of *Lonchocorpus sericeus*. The incidence was maximum in flower buds and on par during 10th and 11th WAP with 64.00± 8.76% and 54.00± 4.56%,

Table 1. Incidence of larvae of *M. vitrata* on flowers and pods of dolichos beans (2019)

Weekly observation (WAP*)	Larval incidence** (%)					
	Flowers			Pods		
	Summer	Kharif	Rabi	Summer	Kharif	Rabi
6	6.00± 2.19^{cd}	6.00± 3.58^{e}	10.00± 2.83^{f}	2.00± 1.79^{e}	4.00± 2.19^{e}	4.00± 2.19^{f}
7	8.00± 3.35^{cd}	10.00± 2.83^{de}	16.00± 2.19^{def}	4.00± 2.19^{de}	10.00± 2.83^{de}	12.00± 1.79^{e}
8	24.00± 4.56^{b}	26.00± 4.56^{c}	32.00± 3.35^{c}	12.00± 3.35^{cd}	16.00± 2.19^{cd}	22.00± 3.35^{d}
9	50.00± 4.00^{a}	56.00± 4.56^{b}	68.00± 3.35^{b}	16.00± 4.56^{cb}	20.00± 2.82^{c}	26.00± 2.19^{c}
10	58.00± 4.38^{a}	72.00± 3.35^{a}	80.00± 2.83^{a}	28.00± 5.22^{b}	38.00± 3.34^{b}	44.00± 2.19^{b}
11	20.00± 2.83^{b}	24.00± 2.19^{c}	26.00± 2.19^{cd}	50.00± 6.32^{a}	62.00± 6.57^{a}	68.00± 4.38^{a}
12	12.00± 1.79^{bc}	14.00± 2.19^{cd}	18.00± 1.79^{de}	20.00± 2.83^{bc}	28.00± 3.35^{bc}	34.00± 2.19^{bc}
13	4.00± 2.19^{d}	6.00± 2.19^{e}	12.00± 3.35^{ef}	16.00± 3.58^{bc}	20.00± 2.83^{c}	22.00± 1.79^{d}
CD (p=0.05)	10.53	9.70	7.79	12.93	9.52	7.38
SEd	5.14	4.73	3.80	6.31	4.64	3.60

*WAP – weeks after planting; **Mean of five replications (Mean± SE); In a column, means sharing similar letter(s) not significantly different (LSD p=0.05).

Table 2. Incidence of larva of *M. vitrata* and its abundance vs. developmental stages of dolichos beans (Summer 2019)

Weekly observation (WAP*)	Larval incidence** (%)				Larval abundance**			
	Flower buds	Open flowers	Immature pods	Mature pods	Flower buds	Open flowers	Immature pods	Mature pods
6	6.00± 2.19^{d}	0± 0.00^{c}	0± 0.00^{e}	0± 0.00^{e}	3.4± 0.46^{d}	0.2± 0.18^{c}	0.6± 0.22^{f}	0.6± 0.22^{g}
7	14.00± 2.19^{c}	2.00± 1.79^{bc}	6.00± 3.58^{de}	4.00± 2.19^{e}	7.0± 0.63^{c}	0.8± 0.33^{bc}	1.8± 0.33^{e}	2.0± 0.63^{f}
8	28.00± 1.79^{b}	6.00± 2.19^{b}	8.00± 1.79b^{cd}	10.00± 2.83^{d}	9.4± 0.46^{b}	1.0± 0.40^{b}	2.8± 0.33^{d}	5.0± 1.02^{e}
9	54.00± 4.56^{a}	12.00±1.79^{a}	12.00± 3.35^{b}	16.00± 2.19^{cd}	12.6± 0.61^{a}	1.2± 0.18^{b}	4.2± 0.33^{c}	9.0± 0.63^{cd}
10	64.00± 8.76^{a}	16.00± 2.19^{a}	24.00± 2.19^{a}	38.00± 3.35^{b}	10.4± 0.46^{b}	2.2± 0.18^{a}	6.4± 0.46^{b}	11.6± 0.46^{ab}
11	28.00± 3.35^{b}	2.00±1.79^{bc}	28.00± 3.35^{a}	64.00± 4.56^{a}	6.6± 0.46^{c}	2.6± 0.46^{a}	10.4± 0.46^{a}	13.0± 0.80^{a}
12	16.00± 2.19^{bc}	2.00± 1.79^{bc}	16.00± 3.58 ^{ab}	46.00± 4.56^{b}	3.6± 0.22^{d}	1.4± 0.46^{b}	6.6± 0.46^{b}	10.0± 0.49^{bc}
13	14.00±2.19^{c}	0± 0.00^{c}	4.00± 2.19^{de}	24.00± 4.56^{c}	1.4± 0.36^{e}	0.2± 0.18^{c}	5.8± 0.33^{b}	7.0± 0.63^{d}
CD (p=0.05)	9.38	7.85	9.69	8.36	0.28	0.31	0.28	0.35
SEd	4.57	3.83	4.73	4.08	0.58	0.65	0.58	0.73

*WAP – weeks after planting; **Mean of five replications (Mean± SE); In a column, means sharing similar letter(s) not significantly different (LSD P=0.05).

respectively; and in opened flowers maximum of 28.00± 3.35% was observed. The present results that mature pods sheltered more larvae compared to immature pods agree with those on yard-long bean by Jayasinghe et al. (2015). A similar trend was also recorded with respect to the larval abundance (Table 3); maximum of 13.00± 0.80 was in mature pods followed by 12.6± 0.61 in flower buds. Jackai (1981b) and Jayasinghe et al. (2015) reported that the later instar larvae of *M. vitrata* exhibited higher abundance in mature pods in cowpea and yard-long bean, respectively.

The larval length was significantly different among the sampled plant components (Table 4); 1-5 mm long ones were most prevalent on the flower buds followed by opened flowers and immature pods, while 9- 16 mm long ones were more in the matured pods.; larval length-frequency ranging from 1- 3 mm (I instar) was predominant in the flower buds (5.4± 0.46) followed by open flowers (5.2± 0.52). These observations corroborate with those Sharma et al. (1999) that early instar preferred that flowers compared to pods. The late larval instar (12- 16 mm long) were frequently found in the matured pods (4.00± 0.40), due to the pod size sheltering the pest and the available seed material helping in completing the lifecycle. Jackai (1981b) and Jayasinghe et al. (2015) also observed that the final instar larvae of *M. vitrata* were mostly found on the mature pods of cowpea and yard-long bean, respectively. The occurrence of single and multiple larvae of *M. vitrata* on the four different plant components, when analysed revealed that single larva (78.00± 3.35 and 66.00± 5.37%) was in the flower buds and immature pods, respectively during maximum

Table 3. Distribution of *M. vitrata* larval length vs flower buds, open flowers, immature and mature pods of dolichos beans

Larval length frequency (mm)	Larval length frequency*			
	Flower buds	Open flowers	Immature pods	Mature pods
1 to 3	5.4± 0.46^{a}	5.2± 0.52^{a}	3.2± 0.33^{b}	0.4± 0.22^{c}
3 to 5	5.4± 0.46^{a}	3± 0.28^{b}	5± 0.40^{a}	0.8± 0.33^{c}
5 to 9	1.6± 0.22^{b}	1.8± 0.33^{c}	1.6± 0.36^{c}	2± 0.28^{b}
9 to 12	0.4± 0.22^{c}	0± 0.00^{d}	0.2± 0.18^{d}	2.8± 0.18^{ab}
12 to 16	0.2± 0.18^{c}	0.2± 0.18^{d}	0± 0.00^{d}	4± 0.40^{a}
CD (p=0.05)	0.35	0.31	0.32	0.39
SEd	0.73	0.65	0.67	0.81

*Mean of five replications (Mean± SE); In a column, means sharing similar letter(s) not significantly different (LSD p=0.05).

Table 4. Incidence of larva of *M. vitrata*- flower buds, open flowers, immature and mature pods of dolichos beans (single, multiple larva)

Weekly observation (WAP*)	Single larvae** (%)				Multiple larvae** (%)			
	Flower buds	Open flowers	Immature pods	Mature pods	Flower buds	Open flowers	Immature pods	Mature pods
6	6.00± 2.19^{f}	6.00± 2.19^{c}	4.00± 2.19^{d}	0.00± 0.00^{e}	4.00± 2.19^{cd}	0.00± 0.00^{NS}	2.00± 1.79^{d}	0.00± 0.00^{d}
7	32.00± 3.35^{cd}	8.00±1.79^{bc}	14.00± 2.19^{c}	6.00± 2.19^{cd}	8.00± 1.79^{bc}	2.00± 1.79^{NS}	10.00± 2.83^{bc}	4.00± 2.19^{d}
8	58.00± 1.79^{b}	10.00±4.00^{bc}	20.00± 4.00^{bc}	18.00± 3.35^{b}	14.00± 2.19^{ab}	4.00± 2.19 ^{NS}	16.00± 2.19^{d}	20.00± 4.00^{c}
9	62.00± 1.79^{b}	16.00±2.19^{ab}	58.00± 4.38^{a}	28.00± 3.35^{ab}	16.00± 2.19^{ab}	0.00± 0.00 ^{NS}	32.00± 3.35^{a}	38.00± 3.35^{ab}
10	78.00± 3.35^{a}	20.00±4.00^{ab}	66.00± 5.37^{a}	40.00± 4.00^{a}	22.00± 3.35^{a}	8.00± 3.35 ^{NS}	32.00± 3.35^{a}	48.00± 3.35^{a}
11	40.00± 4.90^{c}	24.00±2.19^{a}	28.00± 3.35^{b}	36.00± 2.19^{a}	16.00± 2.19^{ab}	6.00± 2.19 ^{NS}	14.00± 2.19^{bc}	52.00± 3.35^{a}
12	22.00± 3.35^{de}	4.00±2.19^{c}	20.00± 4.00^{bc}	8.00± 3.35^{c}	2.00± 1.79^{d}	0.00± 0.00 ^{NS}	8.00± 1.79^{bc}	24.00± 2.19^{bc}
13	18.00± 1.79^{e}	2.00± 1.79^{c}	6.00± 2.19^{d}	2.00± 1.79^{de}	2.00± 1.79^{d}	2.00± 1.79 ^{NS}	8.00± 3.35^{cd}	16.00± 74.56^{c}
CD (p=0.05)	7.93	11.56	9.41	8.31	9.31	10.03	8.75	9.42
SEd	3.77	5.50	4.48	3.95	4.33	4.90	4.16	4.48

*WAP – weeks after planting; **Mean of five replications (Mean± SE); In a column, means sharing similar letter(s) not significantly different (LSD p=0.05).

flower and pod formation period (10th WAP); while with multiple larvae it was 52.00± 3.35% at 11th WAP, and at the same level- 48.00± 3.35% at 10th WAP in mature pods. These results agree with those of Traore et al. (2013) and Jayasinghe et al. (2015) who reported that the majority of single larvae were observed in the flower buds. The present observations on multiple larvae in mature pods is in contrast due to the migration of late instar larvae from flower buds to the mature pods where sufficient space and food is provided.

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